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Public Utility Commission of Texas
Interim Chairman, Kathleen Jackson
Commissioner Will McAdams
Commissioner Lori Cobos
Commissioner Jimmy Glotfelty
1701 N. Congress Avenue
Austin, TX 78711

Re: Project No. 55837, *Review of Value of Lost Load in the ERCOT Market*

Dear Chairman and Commissioners:

Electric Reliability Council of Texas, Inc. (ERCOT) submits this update regarding the status of the Value of Lost Load (VOLL) study for the ERCOT Region. The Brattle Group (Brattle) and PlanBeyond have completed the proposed VOLL Survey Work Plan, which is attached to this letter. The Work Plan presents the study approach for the survey instruments, survey distribution, and analysis of the survey results, including the anticipated timeline and identification of deliverables and risk factors. Proceeding with this Work Plan will best ensure that the VOLL study is completed and delivered to the Public Utility Commission of Texas (Commission) by the end of the second quarter in 2024, in accordance with the Commission's Order in Project No. 38533.¹

As discussed at the November 30, 2023 Open Meeting and based on feedback received from stakeholders to date, ERCOT continues to recommend that Option 3 be utilized to distribute the VOLL survey to retail customers. For competitive areas of the ERCOT Region, Option 3 entails Brattle and PlanBeyond distributing the survey to customers using Customer Billing Contact Information (CBCI) provided by ERCOT, which ERCOT in turn receives on a monthly basis from Competitive Retailers. ERCOT also has historical kilowatt hour (kWh) energy usage information for customers within competitive areas and can use this information to weight the selection of customers to survey in those areas. Option 3 eliminates the need for transfer of customer contact information from Retail Electric Providers (REPs) to ERCOT outside of the established CBCI process that would have been necessary under Option 1 and would not necessitate competitive stakeholders devoting resources to distribute the survey as would be the case under Option 2.

For Non-Opt-In Entities (NOIE) service areas within the ERCOT Region, ERCOT does not have customer contact information or individualized customer usage data and, accordingly, ERCOT will need to partner with interested municipally-owned utilities (MOUs) and electric co-operatives in order for such partners to conduct the VOLL survey in their respective service areas with instruction and support from Brattle and PlanBeyond. ERCOT has had positive discussions with several NOIEs, but to date has not yet received a commitment from any NOIE. ERCOT plans

¹ See *PUC Review of ERCOT Budget*, Project No. 38533, Order Approving ERCOT's 2024 Biennial Budget and Authorizing the System Administration Fee at 7 (requiring delivery of VOLL study in the second quarter of 2024).

to continue these discussions and encourages any interested NOIE in the ERCOT Region to reach out as soon as possible. If no NOIEs are able to partner with ERCOT on this initiative, the VOLL study will be conducted without taking into account customer preferences in NOIE service areas – thus, impacting the regional diversity benefit across the ERCOT Region. ERCOT appreciates any support from the Commission in encouraging NOIEs to work with ERCOT on this important initiative.

In regard to use of CBCI, as previously noted, 16 TEX. ADMIN. CODE § 25.43(p)(7) appears to permit ERCOT to use such data for purposes other than a mass transition, including for distribution of the VOLL survey to customers, unlike Providers of Last Resort (POLRs) which are required by the rule to only use such data to facilitate a mass transition.² As stated in Appendix F6 to ERCOT Retail Market Guide § 9, customer email address is an optional data element in Competitive Retailers' CBCI file submissions to ERCOT.³ The VOLL Survey Work Plan in Section B(3) addresses the reasons that using email addresses as the primary means of distributing the VOLL survey to most customers will be critical. To ensure that the set of customer email addresses for survey distribution is as robust as possible in order to achieve a sufficient customer sample size, ERCOT requests that Competitive Retailers include in their CBCI file submissions for January and February 2024 any customer email addresses in their organization's possession.⁴ ERCOT anticipates using the customer contact information from the January 2024 CBCI submissions to distribute the VOLL survey; however, in the event of any unanticipated delays and out of an abundance of caution, this request also applies to CBCI file submissions in February 2024.

ERCOT appreciates any feedback that the Commission may have on the VOLL Survey Work Plan, NOIE participation, and the use of CBCI to distribute the survey to customers in competitive areas. ERCOT personnel and Dr. Sanem Sergici, who is a Principal at Brattle and is the team lead for this initiative, will be available at the December 14, 2023 Open Meeting to answer questions.

² Note that ERCOT Nodal Protocol § 1.3.6(1)(h) authorizes ERCOT as a Receiving Party to disclose Protected Information, including CBCI, to a vendor of goods and services to ERCOT so long as the vendor is not a Market Participant, other than to an Independent Market Information System Registered Entity (IMRE) to the extent appropriate for the vendor to carry out its responsibilities in such capacity, and so long as the vendor has executed a confidentiality agreement with requirements at least as restrictive as those in ERCOT Nodal Protocol § 1.3. Brattle is an IMRE and PlanBeyond is not a Market Participant. See ERCOT.com, Market Participants (last accessed on Dec. 7, 2023), available at: <https://www.ercot.com/committees/mktparticipants>. Brattle and its subcontractor, PlanBeyond, have executed ERCOT's Professional Services Agreement (PSA), which includes a confidentiality agreement that meets these requirements in Section 7 of the PSA. See ERCOT.com, Procurement, Professional Services Agreement (last accessed on Dec. 7, 2023), available at: <https://www.ercot.com/about/procurement>. Accordingly, ERCOT may share CBCI with Brattle and PlanBeyond in accordance with the requirements of ERCOT Nodal Protocol §§ 1.3.5 and 1.3.6(1)(h) for purposes of conducting the VOLL survey.

³ See ERCOT Retail Market Guide § 9 Appendix F6 at 9F6-3, available at: <https://www.ercot.com/mktrules/guides/retail/current>.

⁴ This would only apply to customer email addresses already in the Competitive Retailers' possession. No gathering or solicitation of additional customer email addresses is requested.

Respectfully submitted,

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ERCOT Value of Lost Load Study Work Plan

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I. Introduction

A. Purpose of This Report

ERCOT has been asked to undertake a Value of Lost Load (VOLL) study by the Public Utility Commission of Texas (Commission) to determine the estimated value of electric reliability in the ERCOT region. An up-to-date and ERCOT-specific VOLL study will be fundamental to support the Commission's ongoing market design initiatives, including the development of a reliability standard. Moreover, an estimated value of reliable electricity service can be used to assess the economic efficiency of investments in generation, transmission and distribution systems, to strategically target investments to customer segments that receive the most benefit from system improvements, and to numerically quantify the risk associated with different operating, planning and investment strategies.¹

Undertaking this study will involve surveying a large and diverse set of customers to understand the value they place on reliable electricity service. In the ERCOT context, this raises unique challenges due to ERCOT's lack of direct access to customers. Therefore, ERCOT has commissioned a *Phase 1 ERCOT VOLL Survey Scoping Study* to explore viable pathways for implementing a survey that will have a wide representation of ERCOT customers. This scoping study includes three tasks:

- Task 1: Literature Review of recent VOLL studies
- Task 2: Development of a "placeholder" VOLL value for the ERCOT region
- Task 3: Proposed Work Plan to perform ERCOT's VOLL survey.

This report is the deliverable for Task 3 of Phase 1 and represents a high-level work plan for the VOLL study for the ERCOT region, which will be implemented in 2024. Phase 2 will entail performance of the VOLL survey based on the work plan presented here.

¹ Michael Sullivan, Matthew Mercurio, and Josh Schellenberg, *Estimated Value of Service Reliability for Electric Utility Customers in the United States*, 2009, Ernest Orlando Lawrence Berkeley National Laboratory.

B. Study Team

ERCOT issued a Request for Proposal (RFP) for a contractor to perform the VOLL study and has selected The Brattle Group (Brattle) for its expertise in this area and Brattle's subcontractor, PlanBeyond, which brings significant expertise in survey administration. Below, we provide background information on our team.

The Brattle Group provides consulting and expert testimony in economics, finance, and regulation to corporations, law firms, and governments around the world. Brattle's Energy Group assists energy and utility market participants worldwide to anticipate and navigate the challenges and opportunities in changing markets and regulatory environments. Our team will be directed by Dr. Sanem Sergici, who is an economist and a Principal with The Brattle Group with more than 20 years experience in the energy industry. She specializes in assisting her clients on issues involving resource planning, energy transition, electrification, and ratemaking. Our team will be managed by Dr. Charlie Gibbons, an economist and a Senior Associate with The Brattle Group. Charlie specializes in applying sophisticated econometric and statistical models to regulatory and policy issues. The Brattle team will be able to draw upon an experienced team of research analysts in day-to-day execution of the project tasks.

The Brattle Group has partnered with **PlanBeyond**, a full-service market research firm, headquartered in Seattle. PlanBeyond empowers organizations with the data and strategic direction they need to thrive. Since 2017, PlanBeyond has supported clients in the energy and utility categories seeking actionable data to fuel everything from energy product roadmap planning and EV adoption campaigns to low-income energy customer strategy and renewable energy transformation sell-ins. PlanBeyond is a certified minority and woman-owned business (OMWBE) and a certified Small Contractor and Supplier (SCS). PlanBeyond team will be led by Ms. Laura Troyani, the Founder and Research Principal of PlanBeyond. Laura brings nearly 20 years of market research and business strategy experience, blending a background as a research lead for multinational consumer goods companies, start-ups, and local non-profits.

II. Study Approach

We have been asked to develop a VOLL survey study that is consistent with the methodology employed by Lawrence Berkeley National Laboratory (LBNL) to update its Interruption Cost Estimate (ICE) Calculator. LBNL has been supporting and analyzing studies that underlie the ICE Calculator since 2005 and developed a guidebook that offers advice to practitioners looking to conduct their own studies.² We were asked to ensure that the output of our study could serve as an input to the ICE Calculator so as to incorporate data collected for that initiative in Texas into the ERCOT VOLL study as well as to improve the ICE Calculator's coverage and representativeness. Furthermore, we are tasked with conducting and analyzing the survey by the end of June 2024. Because of these factors, we plan to follow the methodology used by LBNL in its surveys. We understand that this methodology has also been deployed in AEP Texas' service area in fall 2023.

In this section, we describe the approach taken in the LBNL surveys, including how the questions differ across customer classes. Based on conversations with ERCOT and relevant stakeholders, we offer our current understanding of the most effective way to reach customers for participation. We also present expected counts of customers to be contacted for participation, response rates, and ultimate response counts by customer class. Lastly, we discuss the econometric modeling techniques that we intend to use to analyze the results.

It is important to note that this work plan is based on our current understanding of likely pathways for recruiting sufficient numbers of residential, small and medium commercial, and large commercial and industrial customers to be able to execute the study. To the extent that new information becomes available after the filing of this work plan on the viability of these pathways, some modifications to the approach and timing might be necessary.

A. Survey Instrument

The form containing the set of questions used to collect survey data is called the survey instrument. LBNL developed three versions of the survey instrument, one for each customer class category: residential; small and medium commercial; and large commercial and industrial. The two commercial survey instruments are largely similar; for the purposes of this work plan, we will

² Michael Sullivan, Myles T. Collins, Josh Schellenberg, and Peter H. Larsen, *Estimating Power System Interruption Costs: A Guidebook for Electric Utilities*, 2018, Ernest Orlando Lawrence Berkeley National Laboratory ("LBNL Guidebook").

not distinguish between the two and simply discuss the commercial survey instrument. These instruments differ quite substantially from the residential instrument. In this section, we provide a high-level overview of the design of each instrument.

The commonality between the instruments is the consideration of various outage scenarios. A scenario is defined based on the season (winter or summer), day of the week (weekday or weekend), start time of the outage, and duration. If combinations of these factors are not limited, these dimensions create an inordinate number of potential permutations for consideration. The more scenarios considered, the less clear the insights can be for any one of them. For this reason, we will review with ERCOT the scenarios considered by LBNL in its surveys in order to identify the ones most relevant to evaluate in this study to identify a smaller subset of the scenarios in the surveys sent to ERCOT customers.

The scenario is introduced by saying, “Without any warning, on a typical [season] [day of week], a complete power outage occurs at [start time]. You don’t know how long it will last, but your [facility/household]’s electricity is fully restored in [duration].”³ Respondents are first asked how disruptive the outage would be, on a scale from 1 to 5. From this point, the two instruments diverge.

1. Residential Customers

Residential customers are asked to select from a list of potential ways they might respond to the specified outage, such as “relocate to an area with electricity” or “stay home and do activities that don’t require electricity”; respondents can select several options. Next, respondents are asked to select among cost ranges that reflect “additional expenses that [they] would otherwise not have to pay” due to the outage.

The key question stems from the premise that “a company that is not [their] electric utility developed a new service that can instantaneously deliver temporary backup power to [their] household” and thereby avoid the outage. The respondent is asked: “The exact cost of providing the service for [the specified outage] is not yet known, but it is believed to be between [range of

³ We note that it might be difficult for respondents to fully internalize the concept of not knowing how long the outage will last alongside being told precisely when power will be restored. Note that there is additional information provided to commercial customers regarding the impact on remote employees and other facilities owned by the company.

potential costs]. Would you purchase the backup service to avoid this single outage for a one-time fee of [either the lower bound or upper bound of the cost range]?”^{4,5}

Depending on the fee proposed and response given in this question, respondents may be asked a follow-up question:

- If the respondent was offered the lower bound of the range and said that they would pay that amount, they are then presented with the upper bound and asked whether they would pay that amount;
- If the respondent was offered the upper bound of the range and said that they would not pay that amount, they are then offered the lower bound to see whether they would pay that amount;
- If the respondent rejects the lower bound cost (either in the first instance or after providing the response pattern in the bullet immediately preceding this one), the respondent is asked to select a reason for not being willing to pay this amount from a set of listed options;
- If none of these conditions hold, no follow-up question is asked.

Next, the respondent is asked to consider a similar scenario, but either the season or day of week is changed. Alternatively, the scenario remains the same, but the respondent is told that advance warning would be provided. The series of willingness-to-pay questions is then repeated (using different lower and upper bounds for the price of the service). In the LBNL instrument currently in use, this sequence is repeated three or four times for each respondent, providing about eight sets of responses to willingness-to-pay questions; we will evaluate whether this is the appropriate number of iterations for the ERCOT study.

Separately, the respondent is asked basic demographic questions and for their experience with outages and response strategies.

⁴ This is a key distinction between the residential and commercial surveys: LBNL analyzes residential respondents’ willingness-to-pay for a service that would avoid an outage, whereas LBNL analyzes the costs of an outage to commercial respondents.

⁵ The LBNL Guidebook notes that this method of eliciting willingness-to-pay is subject to response biases (LBNL Guidebook, p. 58-60). To reduce these biases, the LBNL Guidebook recommends that utilities consider an alternative methodology based on discrete choice experiments (DCE), stating: “DCE surveys could mitigate anchoring bias and would present respondents with choice sets that better resemble an actual choice they would make in purchasing improved reliability... [T]he authors [of the LBNL Guidebook] believe that the development of a standard DCE-based survey design could yield improvements over the existing methodology – eliminating uncertainty about important sources of bias. We recommend that a survey development project be undertaken to design and test alternative survey designs based on DCE” (LBNL Guidebook, p. 64-65).

2. Commercial Customers

For commercial customers, the questions focus on the cost of an outage, not on the willingness-to-pay of respondents to avoid an outage. In particular, they are asked, using free response, to provide estimates of lost sales, damages to materials (such as spoilage of inventory or damage to equipment), incremental labor required to respond to the outage, fuel costs, or any other costs due to the outage scenario. They are also asked to estimate any savings that might materialize.⁶ The survey provides a summary of the respondent's cost estimates, then they are asked to add lower and upper bounds for total costs.

As in the residential case, the scenario is changed slightly, either to a different season or day of week or through advance notice being given. The respondent is asked to provide only total losses under this adjusted scenario. Commercial respondents are asked to consider three or four additional scenarios (plus the altered scenarios). However, they are not asked to provide detailed cost breakdowns in these cases; instead, they are asked to provide total losses along with lower and upper bounds. As for residential respondents, we will evaluate whether this count of scenarios is appropriate for the ERCOT study.

These respondents are also asked for “demographics” for the firm, such as industry and employment level, along with experience with outages and available sources of backup generation.

B. Survey Implementation

As noted in ERCOT's November 21, 2023 filing to the Commission in Project No. 55837, the VOLL surveys will be distributed to customers primarily via email using unique hyperlinks to a proprietary website hosting the survey (although in some instances mailing the survey may be necessary). ERCOT, Brattle, and PlanBeyond have been coordinating with transmission and distribution utilities (TDUs), non-opt in entities (NOIEs), and retail electric providers (REPs) to attain a representative sample of customers throughout the ERCOT region. Based on these discussions, we have identified three initial options to distribute the survey to customers:

1. Brattle and PlanBeyond perform respondent recruitment using customer contact information provided by REPs, TDUs, NOIEs and/or ERCOT;

⁶ The primary difference between the small & medium commercial customers and the large commercial customer series of questions is that large customers are asked to disaggregate the sources of potential savings.

2. REPs, TDUs, and NOIEs perform respondent recruitment using their own customer contact information under Brattle and PlanBeyond's instruction; or
3. A hybrid option in which Brattle and PlanBeyond recruit respondents from competitive areas using Customer Billing Contact Information (CBCI) from ERCOT, while relying on NOIEs to perform recruitment in their service territories.

Through these communications with parties, we have further identified that the support for Options 1 and 2 are very limited. Therefore, for the purposes of developing this work plan, we have assumed that Option 3 will be the survey implementation method.

Below, we discuss pertinent survey planning parameters, including target sample sizes, survey implementation approaches by class, target sample sizes, outreach channels, and draft messaging.

1. Survey Implementation by Class

As described above, each customer type will receive a survey targeted to their particular background. Each survey will be programmed and hosted separately to facilitate outreach and completion tracking.

Residential: Residential participants will be invited to participate in the survey via direct email outreach and potentially physical mailings. Contact information for competitive areas of the ERCOT region will be sourced from ERCOT's CBCI customer lists. We will use this list combined with information from ERCOT regarding historical usage of competitive-area customers to segment customers. We will begin with outreach to approximately half of our expected sample size (1,000 customers), who will receive an initial email invite followed by a reminder invite. We will track completion rates by customers segments and target additional customers in each group until the desired sample sizes are achieved.

All residential respondents will receive a unique authentication code to access the survey, which ensures that surveys are only completed once by any given respondent. Upon completion, respondents will have the opportunity to opt in to receive a \$20 incentive. Incentives will be processed and distributed within 4-6 weeks of the data collection window closure.

Small & Medium Commercial: Outreach to Small & Medium Commercial customers will follow the same process outlined for Residential customers. However, given the smaller number of viable contacts available in the CBCI data for this cohort, we anticipate fewer outreach groups.

ERCOT is exploring support from trade associations to bolster outreach to these customers. Small & Medium Commercial participants will be eligible for a \$50 incentive upon survey completion.

Large C&I: Due to the extremely small number of Large C&I contacts available in the CBCI list, we will rely on trade associations (e.g., Texas Industrial Energy Consumers, TIEC) to conduct outreach to their members. Individual trade associations (and potentially REPs as well) will be supplied with outreach email templates that provide a background on the study and offer context to encourage participation. These templates will include a generic, multi-use link allowing anyone receiving it to participate in the survey. This distribution method is necessary to enable the sharing of the link among internal personnel within those member organizations. The use of this type of invitation approach prevents the ability to offer financial incentives, as there is no way to limit survey completion by one individual.

It is important to note that the CBCI list only includes customers served by Competitive Retailers in the ERCOT region. At this point, the study team is in discussions with the NOIEs, which are Municipally-Owned Utilities (MOUs) and electric co-operatives operating in Texas. If it is not feasible to survey the customers served by NOIEs due to unavailability of NOIE participation, the study will only address the VOLLs for those customers in competitive areas of the ERCOT region.

2. Target Sample Size

The table below provides sample size recommendations from the LBNL ICE Guidebook by customer class and the sample size that we propose for this study.⁷ The difference in sample sizes by class are a reflection of the risk factors outlined below, mitigation of which will impact sample sizing.⁸

	LBNL Suggested Target Sample Size	ERCOT VOLL Study Target Sample Size
Residential	1,000 – 1,500	1,000
Small/Med. Comm.	1,000 – 2,000	250
Large C&I	100 - 200	100

⁷ LBNL Guidebook, p. 48.

⁸ We also continue to review other VOLL studies to assess their sample size choices, as well as response rates. This assessment may lead to alterations of the targets presented here.

3. Outreach Methods and Messaging

Email offers several benefits over physical mailings for survey research and will therefore serve as the primary outreach channel in this study. Email allows respondents to receive an initial invitation as well as follow-up invitations in a much shorter period. Accordingly, this enables researchers to assess completion rates earlier in survey execution, which facilitates faster outreach batching and shorter data completion windows.

Further, due to the electronic nature of the survey itself and the use of electronic gift card incentives, individuals are required to have access to a computer or mobile device to complete the survey and to receive their incentive.

Specific elements will be included in all outreach messaging to enhance perceptions of legitimacy, encourage participation, and fully communicate qualification criteria. Outreach materials, such as email messaging, will be branded to enhance perceptions of legitimacy and encourage click-through rates; to maximize legitimacy, we encourage the Commission to permit use of their branding on these materials. Additional information that will be included in outreach materials includes:

- Context indicating the purpose of the study and how the data will be used;
- Expected completion times;
- Incentive values, if relevant;
- Participation deadlines;
- ERCOT email address for respondent questions; and
- Customized hyperlink and/or unique identifier for participation.

We also propose creating an informational webpage hosted by the Commission that can be linked in the outreach that would serve to verify the Commission's support for this study and provide additional context for the project.

C. Sources of Respondent Bias and Potential Statistical Adjustments

The ideal scenario for analyzing the results of a survey is when the respondents are perfectly representative of the larger population. Even in the most rigorous endeavors, this is never the case. For example, even if participants are randomly selected from the full population of interest,

not everyone selected responds the survey request. This itself would be innocuous except that those who do respond often differ from those who do not. Almost every survey (even the US Census, which strives to capture every single US resident) has so-called non-response bias to some degree. Because those who do not respond are by definition not observed, such bias can be difficult to account for using statistical methods.

In the respondent selection approach discussed above, we have another layer of potential bias: due to data limitations, we are not able to select participants from across the ERCOT region. This is due to three reasons:

- Among NOIEs, we are limited to select among respondents from those MOUs and cooperatives who choose to assist with the study, if any.
- Within competitive regions, not all REPs provide email addresses as part of their CBCI submissions; customers of REPs who do not provide this information cannot be selected.
- Within REPs who do provide email addresses, not all customers have provided email addresses and thus customers without email addresses cannot be reached.

These exclusions would not engender bias in our analysis if those customers who are excluded are on average similar to those who are included. We may be able to statistically adjust our sample to make this condition more likely using post-stratification weighting.⁹

This approach up-weights some respondents and down-weights others. For example, suppose that customers are equally divided between north and south regions, but only one-quarter of respondents are from the north. In this case, we give double weight to northern respondents and two-thirds weight to those in the south, generating a weighted sample that is equally divided. This example illustrates that respondents can be re-weighted using factors that are known for *both* respondents and non-respondents. This idea can extend further to reduce bias among eligible and ineligible participants (*i.e.*, those who could not be invited to participate in the study) as well.

Some potential weighting approaches include:

- For each REP, we have physical address information for all customers along with their class. Hence, we can divide customers into geographic regions and weight responses to reflect the

⁹ This is in contrast to (pre) stratification or “balancing” that may be performed to select participants.

share of a REP's customers in that region and class.¹⁰ This will reduce bias to the extent that customers in a given class and geographic region are on average similar to other customers from that class and region. An example violation of this requirement would be that residential customers who have not provided an email address (and therefore could not be part of the survey) are older or have lower incomes than respondents, which could impact their responses to outages.

- The bullet above applies to REPs for whom we have some email data and therefore some responses. For REPs whose customers we cannot reach, we nonetheless have physical addresses and customer class. Hence, we can further weight customers in a region-class to account for customers of excluded REPs. This would reduce bias so long as customers of REPs who provide email addresses in their CBI are similar to customers in the same region-class of REPs that do not.
- For NOIEs who assist in the study, if we have a full customer list, we can apply the approach outlined in the first bullet above.
- For NOIEs where we lack full customer counts—or even any customer responses due to lack of participation by the NOIE—we require some information regarding customer counts by class within a geographic area. We could use US Census data to calculate average household or average firm characteristics within the area and weight respondents in demographically similar areas to account for non-participating NOIE customers.

The success of post stratification weighting depends upon the data available, the “predictability” of who participates in the survey, and the anticipated similarity of respondents and non-respondents. These qualities cannot be fully evaluated *ex ante*. If responses to the survey fail to meet these criteria sufficiently, it may be preferable to perform no weighting at all.¹¹ We will evaluate these kinds of approaches during the analysis of the responses.

D. Analysis of Survey Results

The appropriate methodology to use to analyze data is largely determined by how the data has been collected—in this study, based on how the sample was collected and what questions were

¹⁰ Note that this is a relatively meager set of variables to use for adjustment. The LBNL Guidebook, for example, also recommends using historical usage as a stratification variable (LBNL Guidebook, Section 4.2). It may be possible to supplement this approach by incorporating average demographics in the sub-regions (e.g., average income or share Hispanic within the respondent's ZIP code).

¹¹ Essentially, the weights themselves would be biased and thus introduce an additional source of error.

asked. Because residential and commercial customers will be asked different types of questions to elicit the values used by the LBNL ICE Calculator (willingness-to-pay and costs incurred respectively), the models used for each class will necessarily be different.

In this section, we provide the econometric models we anticipate applying to the survey responses by customer class. We also discuss some data filtering steps that we may consider to ensure the quality of responses. Though econometric theory provides a critical guide for selecting these methods, they may be altered or refined upon reviewing the actual response data.

1. Data Quality Checks

Before inputting the survey responses and estimating the model, we will evaluate each response for reliability. We may consider removing responses that exhibit the following characteristics, each of which suggests that the participant may not have been sufficiently engaged in the survey:

- Unusually fast (“speeding”) or slow survey completion times;¹²
- Providing the same response (such as 0 cost) to all questions (so-called “straight-lining”); or
- Contradictory or inconsistent responses.

The exact approach and applicability for assessing each of these criteria is survey-dependent and will be determined after performing a basic review of the response patterns.

2. Residential Willingness-to-Pay Model

The residential survey asks a series of questions regarding the respondent’s willingness-to-pay (WTP) for a service that would have avoided a given outage scenario. The respondent is first offered either a “low” or “high” price for this service and, depending upon the price offered and the stated purchase intention, the respondent may receive a second question asking whether they would purchase at the other price; the table below outlines the relationship between the stages.

First stage response	
Yes	No
<hr/>	

¹² The LBNL survey instruments instruct respondents that the survey is expected to take 10 minutes for residential customers to complete and 20-40 minutes for commercial customers to complete.

Price offered in first stage	Low	Second stage: Offer high price	No second stage
	High	No second stage	Second stage: Offer low price

To incorporate these features, our econometric model needs to:

- Be based on yes-or-no (“discrete”) purchase decisions
- That may be made once or twice with different price points for a given scenario.

To address the first requirement, a discrete choice model is appropriate. The logistic or “logit” model is commonly used in this context because it can be derived from consumer utility maximization—that is, it links economic theory to a statistical method. In fact, mixed logit models can be shown to be capable of approximating any form of consumer utility.¹³ Here, “mixed” means that different types of consumers with different preferences are assumed to “mix” together. A further extension of this approach enables modeling how demographically-similar consumers may have similar preferences; this is achieved using hierarchical Bayesian models, which have become standard in the marketing literature when analyzing consumer preferences.^{14,15} We anticipate using such models here.

A typical hierarchical Bayesian logit model is based on a single stage of questioning for a given scenario. Such a model could be applied directly by ignoring the second stage of the WTP question sequence. The model could also be adjusted to incorporate the second stage, which would yield more statistically-precise results at the expense of a more complex mathematical formulation. We will apply the standard model first and, if the results are sufficiently precise, we may conclude with that model. If additional precision is required, we will develop a model that incorporates results from the second stage.

¹³ Daniel McFadden and Kenneth Train, 2000, “Mixed MNL Models for Discrete Response,” *Journal of Applied Econometrics*, 15: 447-470.

¹⁴ Andrew Gelman and Jennifer Hill, 2006, *Data Analysis Using Regression and Multilevel/Hierarchical Models*, Cambridge University Press. “Hierarchical” means that each respondent has their own preferences that are a function of the group they belong to, which has a particular distribution of typical preferences among its members. “Bayesian” means that the model starts with assumptions about anticipated WTP values, which in this study will be informed by prior VOLL studies. The model can be tuned to largely override these so-called “prior” assumptions, which places the focus on the data collected in this particular study, or to be informed by that earlier work, which reduces the statistical uncertainty in the estimates by incorporating the additional information from earlier research.

¹⁵ Greg M. Allenby and Peter E. Rossi, 2006, “Hierarchical Bayes Models,” in *Handbook of Marketing Research: Uses, Misuses, and Future Advances*, Rajiv Grover and Marco Vriens (eds.), SAGE Publications.

This model will provide direct estimates of the distribution of the willingness-to-pay to avoid an outage having specific characteristics across residential respondents, perhaps as a function of demographic factors. If we deem it appropriate to post-stratify our results, then we can weight these distributions, then aggregate them to provide the overall distribution of WTP across residential customers in the ERCOT region.

3. Commercial Avoided Cost Model

While consumers were asked a yes-or-no choice of whether to purchase protection against an outage, commercial customers are asked for the cost of addressing an outage. The inputs to the ICE Calculator become a residential customer's willingness-to-pay to avoid an outage and, for a commercial customer, the costs it avoids if an outage is averted. Because these quantities are different (notably, one is binary and the other can be any non-negative number), the modeling strategy must be different.

To model commercial customers' avoided costs, we anticipate using a Poisson model.¹⁶ Much like with the residential class, we plan on estimating this model using a hierarchical Bayesian approach that allows each commercial customer to have different cost responses to different types of outages. Also, as in the case of residential respondents, these different responses may be similar for firms with the same "demographics"—such as industry, size, or location.

Once again analogous to the residential case, this model will yield estimates of the distribution of costs across firms that may be a function of firm characteristics. These can be aggregated using post stratification, if appropriate.

III. Study Timeline

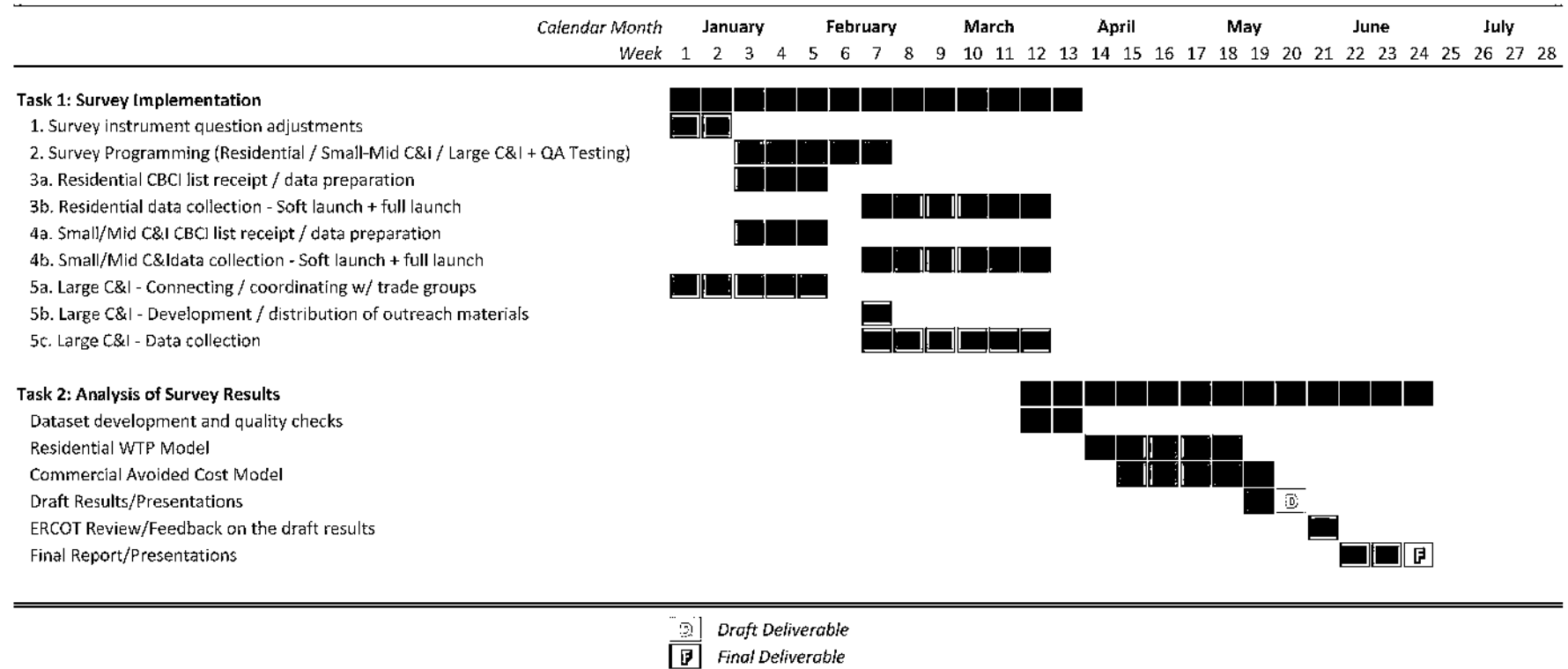
The study includes two distinct tasks. Task 1 is the survey implementation and data collection phase and Task 2 is the analysis of the survey responses to develop the VOLL estimates. We have developed a Gantt chart (Figure 1) that reflects our best estimate of when key project activities will need to be executed to ensure the delivery of a final study report by the end of Q2 in 2024.

¹⁶ We may also consider a negative binomial model, which is a more flexible form of the Poisson model. Each of these models permit some responses to be exactly 0, but if there are a non-trivial number of commercial respondents that indicate zero costs for outages (under some or all scenarios), we will consider modifications of these models that account for "excess" zero values (known as zero-inflated models).

This timeline assumes immediate access to the LBNL survey instruments, including the lost load scenarios tested with each customer class. Delays in access to these scenarios may extend the survey-programming phase and delay when we can commence outreach. Delayed outreach will push out the timeline for data collection and in turn may lead to problems with meeting the Q2 2024 deadline for the study completion.

Currently, there is no plan for REPs and/or TDUs to do any direct outreach to their customers or provide their customer lists for PlanBeyond / Brattle's direct outreach. Should any of these organizations wish to participate and support the VOLL survey effort, we may need to extend the data collection window to accommodate their internal processes.

FIGURE 1: PROPOSED STUDY TIMELINE



IV. Study Deliverables

This study will produce five deliverables:

1. Final survey instrument with necessary modifications to the LBNL's survey instruments to ensure that ERCOT's objectives for the VOLL study are met
2. Datasets of survey responses to be shared with LBNL for the update of their ICE Calculator
3. A PowerPoint report with draft results
4. A written draft report describing the survey approach, analysis methods, and results
5. A written final report describing the survey approach, analysis methods, and results

V. Risk Factors & Challenges

In the course of outlining our approach and methodology above, we noted several challenges that create risk for the completion of this study. Below, we highlight these risk factors.

- ***Limited support from study partners, which impacts survey execution:*** A thorough exploration of partnering with various stakeholders (*e.g.*, REP's, NOIEs) indicated that these groups would be unwilling or unable to play key roles in the customer outreach or data collection. This leads to the use of CBCI data, which is limited to customer contact information for competitive areas of the ERCOT region. Further, the limited representation of Large C&I contacts in the CBCI data leads to our reliance on trade associations to reach this cohort. The results of this participation are uncertain. Due to these limitations, we may have difficulties or delays in meeting target sample sizes for some customer classes. In the case of the Large C&I class, we may not be able to meet the sample target sizes, or receive sufficient number of complete survey responses. In that case, we may need to consider alternative approaches to estimate Large C&I customer VOLL values, such as relying on the Large C&I customer survey results that AEP Texas, Inc. recently collected as part of LBNL's ICE Calculator 2.0 initiative.
- ***Sample may not be representative of the entire ERCOT region and customer base:*** CBCI data is only provided by REPs and only some REPs provide customer email addresses. The resulting set of contacts likely differs from the entirety of ERCOT's customer set in terms of customer profile, geography, energy usage patterns, and other criteria. This means that using CBCI data will yield a sample set that may not be wholly representative of ERCOT's region and customer base.